

# **Geostationary Operational Environmental Satellite (GOES)**

**GOES-R Series**

## **Unique Instrument Interface Document (UIID) Solar Imaging Suite (SIS)**

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## 1 Scope

The purpose of this Unique Instrument Interface Document (UIID) is two-fold. The first is to allocate GOES-R series spacecraft resources to the Solar Imaging Suite (SIS). The second is to serve as a core building block on which the SIS-spacecraft interface can be designed. The spacecraft integrating contractor and the SIS contractor **shall** meet each of their respective interface requirements as defined in this document.

The Government **will** be the system integrator until a system performance contractor or spacecraft contractor with that responsibility is selected. Until that time, the Government **will** be responsible for accommodation trades, resource allocation (weight, power, space, bandwidth, etc.), and resolving interface issues. This UIID **will** govern the development of an Interface Control Document (ICD). The ICD development **will** be a joint activity of the SIS and spacecraft contractors.

The SIS ICD establishes the details of the electrical, communications, mechanical, thermal, integration and test, and command and data handling (C&DH) interfaces between the SIS instrument and the GOES-R spacecraft. After the ICD is signed and approved by all parties, the spacecraft contractor **shall** maintain the ICD.

The SIS consists of the Solar X-ray imager (SXI), the solar X-ray sensor (XRS), and an extreme ultraviolet sensor (EUVS). This instrument suite requires primary power and command input data from the spacecraft. Instrument output data to the spacecraft contains instrument information, instrument telemetry and ancillary data.

### 1.1 Document Overview

Together, the General Interface Requirements Document (GIRD) and the SIS UIID establish the SIS spacecraft interface requirements. The GIRD applies to all GOES-R instruments while the SIS UIID is specific to the SIS. Section 1 explains the use of this document. Section 2 lists reference documents. Section 3 allocates spacecraft resources, such as mass, power, and data rate, to the SIS instrument Suite. Section 4 contains verification guidelines. Section 5 contains government-accepted operation constraints. Section 6 contains government-accepted deviations from the GIRD.

### 1.2 Conflicts

Within the hierarchy of GOES-R spacecraft documentation, the SIS Performance and Operational Requirements Document (SIS PORD) **shall** take precedence over the SIS UIID. In the event of any other unresolved conflict, the National Aeronautics and Space Administration (NASA) contracting officer **shall** determine the order of precedence.

### 1.3 Interface Control Management

The configuration management/control of this document **will** be maintained by the GOES Project Configuration Control function. Additions, deletions, or modifications to this

document **may** be initiated by any participating agency by submittal and approval of a Contract Change Notice (CCN) or technical directive.

### **1.4 Missing Requirements**

This document contains all performance requirements for the sensor except those labeled “TBD”, “TBS”, and “TBR”. The term “TBD” (To Be Determined) means that the contractor **shall** determine the missing requirement in coordination with the government. The term “TBS” (To Be Specified) indicates that the government **will** supply the missing information in the course of the contract. The term “TBR” (To Be Reviewed) implies that the requirement is subject to review for appropriateness by the contractor or the government. The government **may** change “TBR” requirements in the course of the contract.

### **1.5 Definitions**

The following definitions apply:

#### **1.5.1 Shall**

The requirements in this document are not of equal importance or weight. “**Shall**” designates the highest weighting, i.e. mandatory. Any deviations from these contractually imposed mandatory requirements require the approval of the NASA contracting officer.

#### **1.5.2 Should**

“**Should**” designates an intermediate weighting, i.e. not mandatory. Unless required by other contract provisions, noncompliance with “**should**” requirements does not require contracting officer approval, but **shall** require documented technical substantiation.

#### **1.5.3 Will**

“**Will**” designates a lower weighting level. The “**will**” requirements indicate the intent of the Government and are often stated as examples of acceptable designs, items and practices. Unless required by other contract provisions, noncompliance with the “**will**” requirements does not require approval of the NASA contracting officer and does not require documented technical substantiation.

#### **1.5.4 May**

“**May**” designates the lowest weighting level. It is a requirement that is a possibility and is at the discretion of the Government or contractor.

#### **1.5.5 Normal Operational Periods**

Normal operational periods are defined as all periods except during housekeeping, stationkeeping, and eclipses.

### **1.5.6 Instrument Data Latency**

Elapsed time from end of data collection in the instrument to the time that the data is available at the instrument /spacecraft interface.

### **1.5.7 Spacecraft Data Latency**

Elapsed time from when instrument data is available at the instrument /spacecraft interface until it is transmitted to the ground.

## **2 Applicable Documents**

The following documents are referenced in this specification.

## **3 Allocations**

The GOES-R spacecraft **shall** provide communications, power and a Sun-pointing frame for the SIS instruments throughout the entire spacecraft mission including eclipse periods. The following paragraphs allocate these resources to SIS.

### **3.1 Command and Data Handling**

#### **3.1.1 Instrument-to-Spacecraft Data Volume**

The SIS data rate including all SIS housekeeping data and packet overhead data **shall** be no more than 2.8 Megabits per second (TBR).

#### **3.1.2 Instrument-to-Downlink Data Requirements**

##### **3.1.2.1 Spacecraft Latency Requirement**

The spacecraft **shall** meet the following latency requirements for SIS Instrument data:

Solar X-Ray Imager	- 10 seconds (TBR)
Extreme Ultra Violet Sensor	- 3 seconds (TBR)
X-Ray Sensor	- 1 Second (TBR)

##### **3.1.2.2 SIS Data Time Tag Requirement**

The spacecraft **shall** provide time tagging of the SIS data with an accuracy of 1 millisecond (TBR).

##### **3.1.3 Advance Notice of Change in Sun-Pointing Frame**

The Spacecraft **shall** provide the SIS advance notice of a change in the Sun-pointing frame position. This advance notice **shall** be at least 100 ms. (TBR).

##### **3.1.4 Spacecraft Telemetry Required for SIS Data Processing**

Spacecraft telemetry required to analyze SIS data **shall** be provided whenever

SIS data is available, with the same latency specified for the SIS data in paragraph

3.1.2.1. The housekeeping data that is required to analyze the SIS data includes:

- Spacecraft attitude data

- Spacecraft thruster status

- Sun-pointing frame pointing direction

- (TBR)

### **3.1.5 Spacecraft Clock Signal**

The spacecraft **shall** provide the spacecraft clock signal to the SIS for the time stamping of data.

## **3.2 Power**

### **3.2.1 Average Power**

The SIS **shall** draw no more than 130 Watts (TBR) averaged over five (5) minutes (TBR).

### **3.2.2 Peak Power**

The SIS total peak power input including heaters **shall** be no more than 135Watts (TBR) over 30 seconds (TBR).

### **3.2.3 Survival Power**

The SIS **shall** require no more than 50 Watts (TBR) to maintain survival temperatures.

## **3.3 Mechanical**

The requirements in this section apply to the structural and mechanical components of the instrument flight units.

### **3.3.1 Mass Properties**

The instrument, including all units and cabling between units, **shall** have mass less than 60 kilograms (kg) (TBR).

### **3.3.2 Volume**

The instrument, including mounts, thermal blankets and connectors for both stowed and operational configurations, **shall** have a volume not to exceed 83000 cu. cm. (TBR).

### **3.3.3 Mounting**

The spacecraft **shall** provide a Sun-pointing frame for mounting the SIS.

#### **3.3.3.1 Sun-pointing Frame Sun Scan**

The spacecraft Sun-pointing frame **shall** initiate, upon command, a 1.5 degree scan centered on the Sun to support SIS flat field measurements. The spacecraft **shall** provide a priori notice of the sun scan, to the SIS with an accuracy of 100 milliseconds (TBR).

### 3.3.4 Fields of View

The SIS **shall** have the following unobstructed fields of view, free of glint from the spacecraft:

#### 3.3.4.1 View of Sun

The SIS instruments **shall** have continual unobstructed 53 (TBR) arcmin full-width East-West view and 53 (TBR) full-width arcmin North-South view of the Sun during normal operational periods.

#### 3.3.4.2 Off-Sun Field of View

The SIS instruments **shall** have a 56.5 arcmin radius full circle field of view centered at least 90 arcmin from the center of the Sun to support off-Sun pointing for calibration.

### 3.4 Disturbances

The following requirements supercede those of the GIRD paragraphs 3.1.7. These requirements apply during normal operational periods.

#### 3.4.1 Spacecraft-to-Instrument

##### 3.4.1.1 Spacecraft Pointing

For each orthogonal axis on the spacecraft side of the instrument sensor unit interface, the maximum SIS Mounting Frame pointing error shall not exceed 250 microradians (TBR).

##### 3.4.1.2 Spacecraft Error Rate

For each orthogonal axis on the spacecraft side of the SIS interface, the SIS Mounting Frame pointing error rate shall not exceed 100 microradians (TBR) per second in magnitude when the rate is filtered by at least a fourth order Butterworth low pass filter with a -3dB response at 15 Hz.

##### 3.4.1.3 Spacecraft Translation Acceleration Limits

For each orthogonal axis on the spacecraft side of each mount point for the SIS interface, the translational acceleration shall not exceed the magnitude limits specified in the Translational Acceleration Limits for Spacecraft to Instrument Table when the acceleration is filtered by at least an eighth order band pass Butterworth filter with a -3dB response at  $f_1$  and  $f_2$ .

**Translational Acceleration Limits for Spacecraft to Instrument Table (TBR)**

$f_1$ (Hz)	$f_2$ (Hz)	Peak Limit (m-g)
0.0	512.0	15.0
0.9	10.1	1.5
6.3	32.0	1.0
20.2	101.6	3.0
64.0	322.5	7.0
203.2	512.0	14.0

#### **3.4.1.4 Spacecraft Pointing Stability**

For each orthogonal axis, North-South or East-West, on the spacecraft side of the SIS interface, the pointing stability during any 24 hours shall be within  $\pm 150$  microradians (TBR).

#### **3.4.1.5 Spacecraft Pointing Control**

The step size of the Sun pointing frame shall be less than 15 arcseconds.

#### **3.4.1.6 Spacecraft Slew of SIS Mounting Frame**

The spacecraft shall have the capability to slew the SIS mounting frame a minimum of TBS degrees for off-sun calibration of the SIS instruments.

### **3.4.2 Instrument to Spacecraft**

#### **3.4.2.1 Instrument Disturbance Torque Limits**

At any time during the operational mode of the spacecraft, the sum of the magnitude of the SIS uncompensated torques and the magnitude of its uncompensated linear forces multiplied by a lever arm of 2 meters shall not exceed 0.001 N-m.

#### **3.4.2.2 Instrument Allowable Angular Momentum**

The magnitude of the SIS's uncompensated angular momentum shall not exceed 0.001 N-m-sec. The instrument contractor **shall** document the angular momentum produced by the instrument in the Instrument Description Document (IDD).

### **3.5 Contamination**

The spacecraft **shall** limit contamination on the SIS, accumulated over the life of the spacecraft to TBD.

## **4 Instrument Constraints**

In order to ensure proper instrument performance or to prevent possible instrument damage, the following Government-approved constraints are imposed by the instrument developer on spacecraft integration and test activities, including launch, activation and operations.

## **5 Deviations and Waivers**

This section identifies General Instrument Requirements Document (GIRD) requirements that the government has relaxed or waived for this instrument. Where appropriate, corresponding GIRD paragraph titles and numbers are identified in parentheses. There are no deviations or waivers at this time.

## **6 Acronyms and Abbreviations**

C&DH	Command and Data Handling
CCN	Contract Change Notice
dB	deci-Bell(s)
EUVS	Extreme Ultraviolet Sensor
GIRD	General Interface Requirements Document
GOES	Geostationary Operational Environmental Satellite
GSFC	Goddard Space Flight Center
Hz	Hertz
ICD	Interface Control Document
IDD	Instrument Description Documents
INR	Image Navigation and Registration
kg	kilogram(s)
m	meter(s)
m-g	milli-g's (Earth's gravitational acceleration)
N	Newtons (unit of force)
NASA	National Aeronautics and Space Administration
PORD	Performance and Operations Requirements Document
sec	second(s)
SIS	Solar Imaging Suite
TBD	To Be Determined
TBR	To Be Reviewed
TBS	To Be Specified
UIID	Unique Instrument Interface Document
XRS	X-Ray Sensor